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Entrepreneurial Opportunity Emergence: Complex Simulation of Emergent Entrepreneurial Phenomenon

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Abstract: This paper predicts possible patterns in entrepreneurial opportunity (EO) generation techniques and argues that EO emerges from the interaction between enduring entrepreneurial exposures. This study investigates the factors of social network (SN), environment (EV), personality traits (PT), knowledge of technology (TE) and prior knowledge (PK). These repeated evolutions and interactions between entrepreneurial ideas are what constitute complex emergence or re-emergence of EO. Entrepreneurial thinking, is a complex process that cannot be explained by the entrepreneurship literature. Therefore, there is a need to shift from entrepreneurial thinking to a more robust and evolutionary system of thinking. This study adopts an emergent system of thinking. Thus, , entrepreneurial ideas and opportunities emerge from a mindset that includes entrepreneurial qualities and a background of expertise and knowledge. The simulated results show a consistent pattern in the PT, EV and PK of entrepreneurs. Also, variations in TE and SN demonstrate a tendency to innovative behaviour. Therefore, 'entrepreneurship' is greatly influenced from its birth by current technologies and the social network of the entrepreneur.

Keywords: *entrepreneurial opportunity, innovation, emergent systems, complex emergent organisations..*

Introduction

Over the decades, the meaning of the term 'entrepreneurship' has evolved so much that the initial, perceived view of embarking on a profitable business, has morphed into managing or making decisions that impact business development. The recent technological or scientific innovations that have already led to further advances in virtually all fields, particularly entrepreneurial systems, are an example of the modern manifestation of entrepreneurship. These advancements have changed how entrepreneurs proceed to create businesses. This study builds on the theory of deferred action which characterises a deliberate organised social action or organisation, such as complex adaptive systems.

Literature Review

There is existence body of literature that attempts to explain how new entrepreneurship opportunities have been organised but little attention has been paid, so far, to how

entrepreneurs proactively and deliberately create or discover new opportunities. (Corbett 2007). Although there is literature which argues that 'entrepreneurship' is a process (Shane 2000a; Marvel et al. 2010; Nicolaou et al. 2009; Elmuti et al. 2011); this paper explains how these opportunities emerge from a creation or discovery process.

For the last five decades, social history has witnessed a transformation that has not been experienced in any time period before. The facts about how people are affected and through what sort of characteristics individuals try to handle this situation has been a multi-perspective issue and has been studied thoroughly in Ruhe (2007) and Gilbert et al. (2005). Understanding intersocietal and interpersonal relationship systems that are based on fluctuation and competition was attempted and studies were carried out to determine what characteristics sustained individuals to survive in this period (Burger-Helmchen 2012; Gilbert et al. 2006).

In the same vein, the study of entrepreneurship in this century can be characterised as the 'import era.' Psychological trait theories, psychological cognition theories, strategy, finance, marketing, sociology network and creativity theories (Stevenson et al. 1990), among others, were imported to form the advancement of entrepreneurship as an academic discipline (Gündoğdu 2012; Baron et al. 2006). Thus far, the results of this prodigious effort are ambiguous at best; findings warrant continued effort in each stream but have failed to produce substantial insights into the nature, process, and dynamics of entrepreneurship (Gaglio 2003; Løwe et al. 2013).

Emphasis will be put upon the fact that opportunity is deliberately and intentionally created through the process of critical thinking (Patel 2006a) and conceptual design (Løwe et al. 2013) and brought to bear in line with the theory of deferred action. Opportunity discovery happens because of an already existing opportunity within the system (Shane 2000b; Shane & Venkataraman 2003; Baron et al. 2006), while opportunity creation results from an insight within an environment that leads to a completely new way of doing things. (Patel 2006b). However, both emerge from the knowledge and expertise interactions within the entrepreneur's know-how.

Since the embedded nature of social behaviour is understood as the way in which action is constrained or facilitated in its social context, there is no doubt that entrepreneurial activity is embedded in the behaviour and social environment of entrepreneurs (Granovetter 1985). The lack of a traditional approach for dealing with the embedded nature of social behaviour has been highlighted (Lichtenstein 2012). A particular focus is placed on critiquing social network, prior-knowledge and personality-based theories - which suggest that people's special personality traits, knowledge or social circle make them very likely to behave and succeed as entrepreneurs. Economic, rational actor theories which are viewed by entrepreneurs as rational, isolated decision-makers; and deterministic, over-socialised models of entrepreneurship are also discussed throughout Kirzner's and Schumpeter's arguments. (Kirzner 1997; Shane et al. 2003).

Methodology

Within the context of this study, a simulation aimed at capturing and rationalising how entrepreneurial ideas are generated, from the consummate interrelationships between the variables is considered and outlined. (Gilbert 2004; Epstein 1999; Sonnessa 2004). Inductive reasoning is used where, with specific observations and measures, patterns and regularities may be detected. Then using these results and findings, the some tentative hypotheses are formulated for further exploration., The study is concluded with the development of some

general findings. A positivist approach is used here in which empirical observation is seen as the way to gain the truth and to understand the world well enough in order to predict, control and manipulate it. In this research the exploration of possible interactions between independent variables, which recreates the dependent variable via perturbative effects, produces a seemingly chaotic yet patterned set of data for investigation.

The mechanism for the simulator designed and deployed for this paper is based on the Bayesian network and probability schema. Since the Bayesian probability is subjective and a measure of the degree of belief or confidence that the operator (the researcher or the reader) has in the truth of a proposition, the simulation follows a stochastic uncertainty where the probability of hitting the target (very positive outcome is set at P = 0.95 maximum).

The conceptual framework is translated into a comprehensive belief network where the probabilistic strengths (outcomes) in the interactions of the parent nodes, determines the character (probabilistic value) of the child. The interactions are governed by the various conditions of relationships between the parent and child nodes and includes external peer influences.

Bayesian Networks

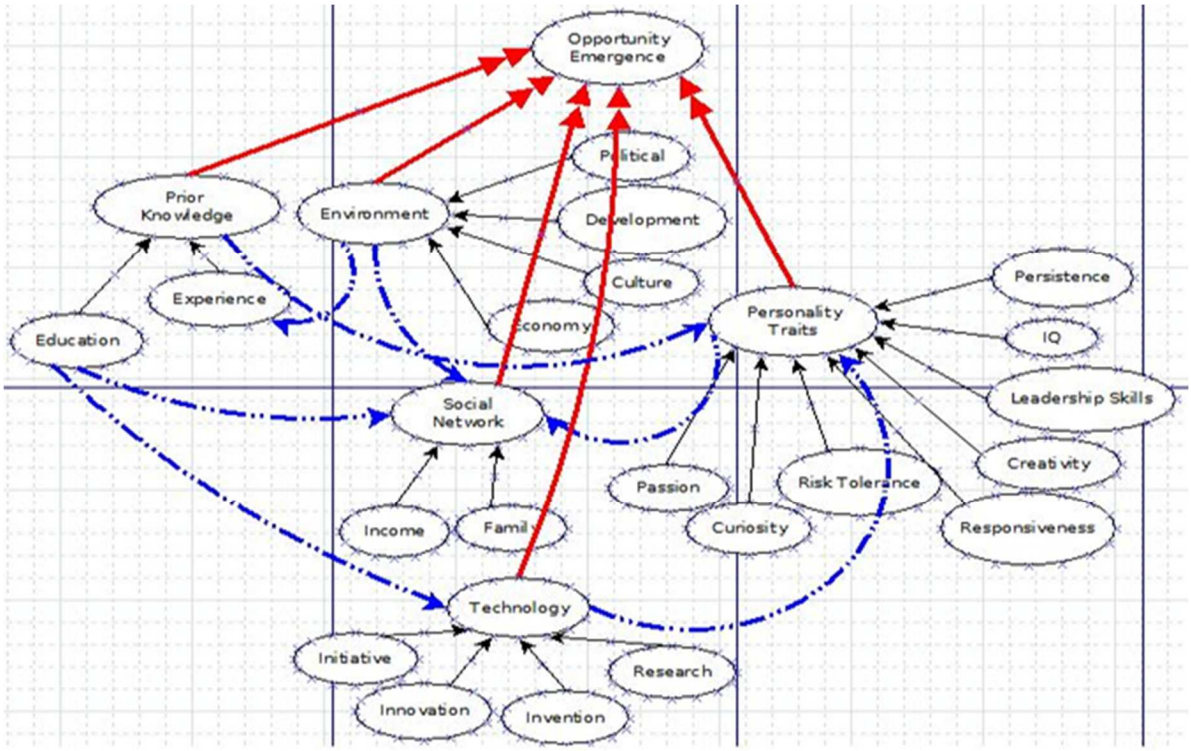
A Bayesian network (BN) is a graphical representation of a joint probability distribution, representing dependence and conditional independence relationships.

A Bayesian network is drawn as a graph for each measurable variable, with nodes and edges. However, as a functional network, the nodes represent the variables being measured (e.g. Technology) and the edges (arrows in conceptual frameworks and the Bayesian graphs) represent the interactions between them.

From the conceptual model (Figure 1), it is observed that opportunity emergence is dependent on five variables which include the following: Technology (TE), Environment (EV), Personality trait (PT), Prior knowledge (PK) and Social Network (SN). These variables are also a function of other independent variables as shown by the conceptual framework. These were selected from the literature and found to be broad enough to encompass foundational emergent behaviours of an entrepreneur's basic requirements.

Figure 1: The red double headed arrows represent the five main characteristic dependent variables of the conceived framework. The blue dashed arrows indicate the interactive and spurious effects of one element on another.

Fig 1: Conceptual Model



The single headed black arrows refer to the independent variables which are measured based on a Likert scale (see Table 1 sample) and fed into the simulator as a probability ratio of the belief network. The Bayesian belief probability model is employed to predict the emergent output (outcome) given the available data from the independent variable at any point in time. The independent variable values are generated using random Likert scale derivatives by the simulator and are fed sequentially into the Bayesian belief network, which is an exact translation of the conceptual framework. A set of outputs from the simulator represents a possibly unique entrepreneurial tally which is further analysed to understand the perturbative contribution of the independent units towards the emergence of the centre (i.e. Entrepreneurial opportunity).

Results

All the graph plots are predicted probable values (Y-axis) against an entrepreneurial occurrence (X-axis). Figure 2 shows a relatively stable output for Prior Knowledge (PK), Personality Traits (PT) and Environment (EV). This indicates commonality for entrepreneurs. However, variations in Technology (TE) and slight variation in Social Network (SN) were the main variables that account for the perturbative effect which influences the emergent behaviour of the entrepreneurial ideas and opportunities.

In this study, however, it is argued that PT is greatly influenced by TE and its recurring advances. This argument relies on the fact that the modern society has been infused with technology to an extent that individuals have seen their personality centred on the kinds of gadgets they possess and how data from these devices determine their actions and rationales because so much data is gleaned every day from our mobile phones, computer devices and internet heuristics. This trend has continued at such a velocity that it defines who an

individual is, and the loss of any one of those devices would quickly reveal how incapacitated people and entrepreneurs have become without technological support.

Fig 2: Plot of simulation results without TE influence on PT

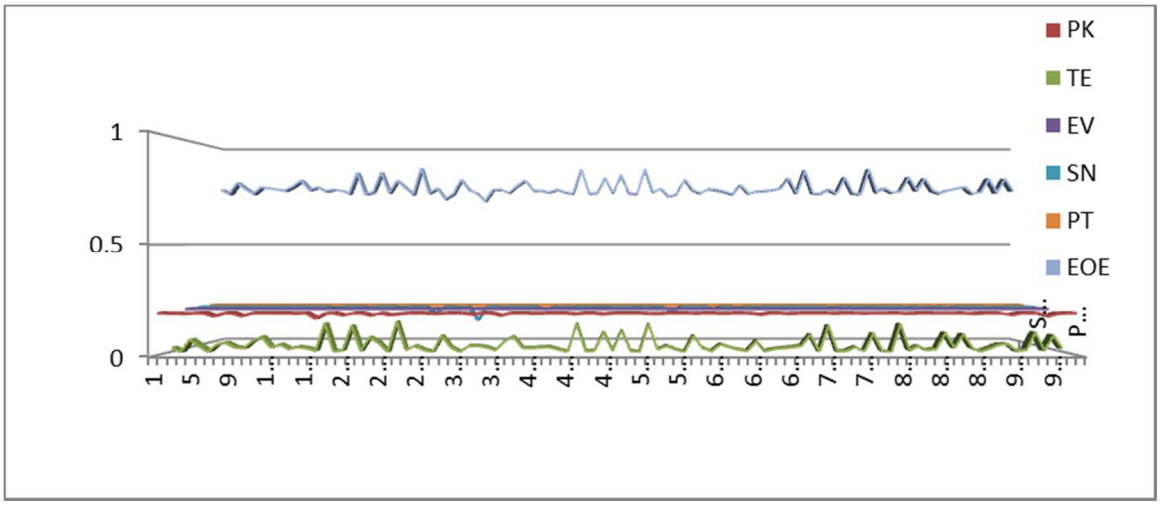


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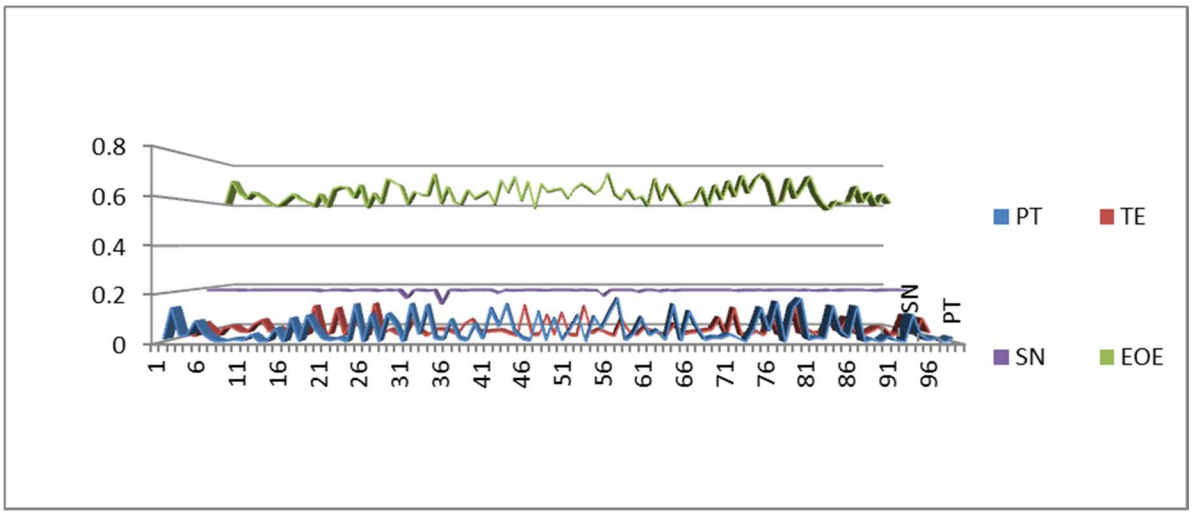
Table 1: Sample Probability score table for Technology on a Likert scale of 1 to 5.

TECHNOLOGY								
Initiative		Innovative		Inventive		Research		Probability
Very Low	1	Very Low	1	Very Low	1	Very Low	1	1/5
Low	2	Low	2	Low	2	Low	2	2/5
Average	3	Average	3	Average	3	Average	3	3/5
High	4	High	4	High	4	High	4	4/5
Very High	5	Very High	5	Very High	5	Very High	5	5/5

All data are randomly generated for the Bayesian probability equations. The prediction by the Bayesian method follows the natural possibility of an occurrence in certain given conditions. Hence, the results show what to expect, given a particular set of an entrepreneur's characteristic score from the framework. Table 1 shows a sample of how technological variables were scaled, in a similar manner; so that it is present in all the other dependent variables (EV, PK, SN and PT). Outlined below are the Bayesian belief probability equations of the variables used in the simulation.

Figure 3: Plot of simulation results with technology influenced personality



Initial probability of Technology contribution is given as

$$P(TEi) = P(TE|Inn,Inv,Init,Research) \ldots\ldots\ldots \; eq(1)$$

Probabilistic value of Technology given the influence of Education is defined as

$$P(TE) = P(TEi) + P(Ed) \ldots\ldots\ldots\ldots eq(2)$$

Figure 4: Bayesian belief network for Technology variable, suggests Technological inclination values is derived given the person's Likert score on initiative, innovativeness, inventiveness, research ability and overall influenced by the level of education. These are together funnelled into the Bayesian equation for a probable outcome value

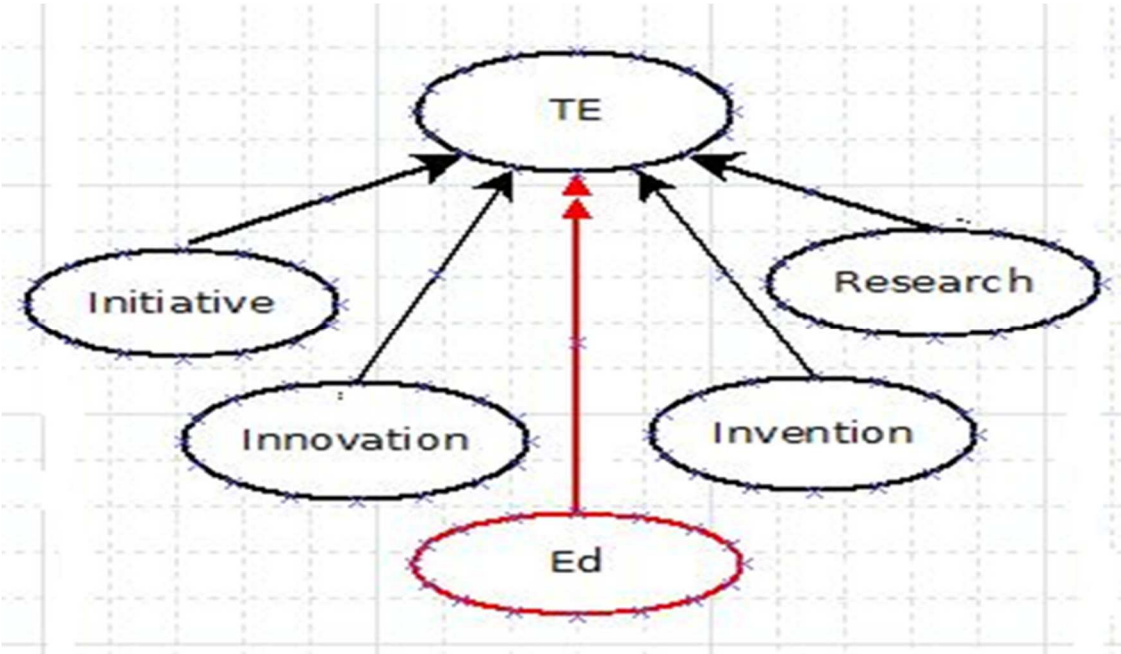
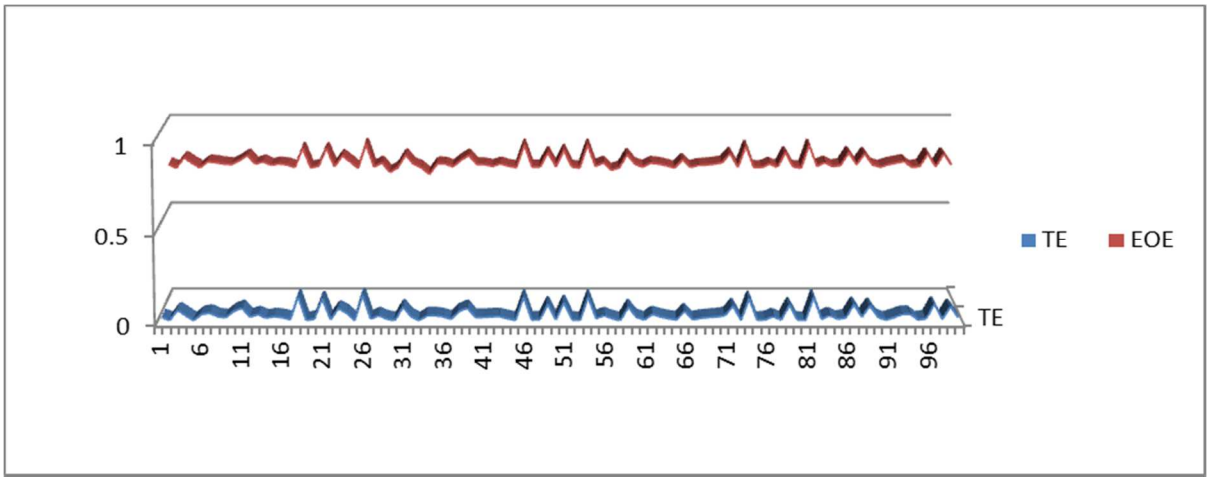


Figure 5: Simulation result plot for TE and EOE (Entrepreneurial Opportunity emergence)



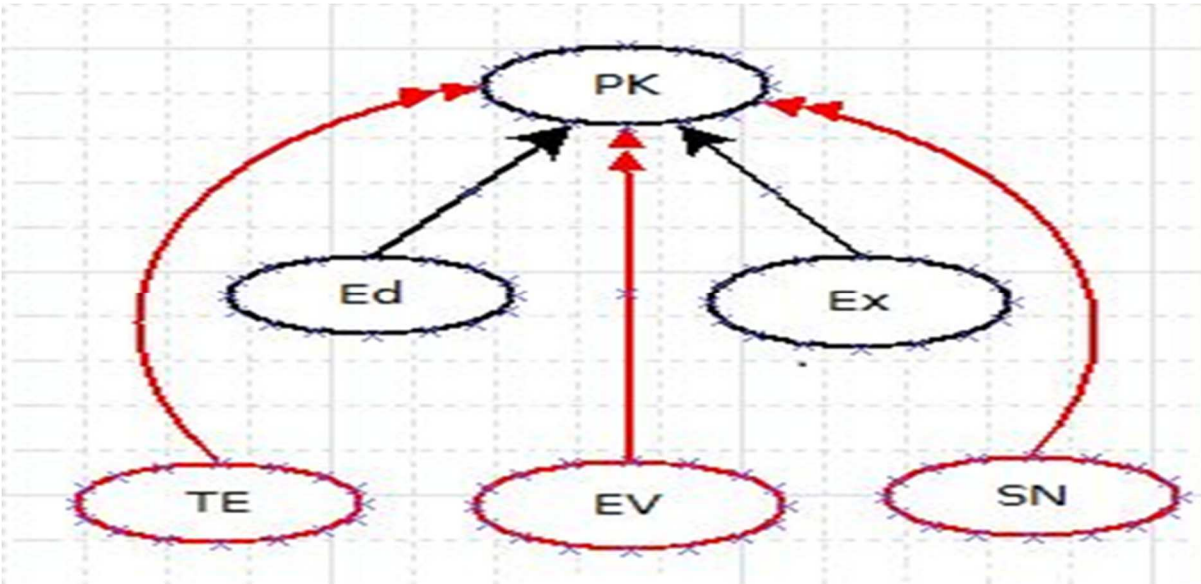
Initial probability of Prior Knowledge contribution is given as

$$P(PKi) = P(PK \mid Education, Experience) \ldots\ldots\ldots eq(3)$$

Probabilistic value of Prior Knowledge given the influences of Technology, Environment and Social Network is defined as

$$P(PK) = P(PKi) + P(TE) * P(EV) * P(SN) \ldots\ldots\ldots eq(4)$$

Figure 6: Bayesian belief network for Prior Knowledge variable



Initial probability of Personality Traits contribution is given as

$$P(PTi) = P(PT \mid IQ, Pers, Pass, Cur, R/T, Resp, Creat, L/S) \ldots\ldots eq(5)$$

Probabilistic value of Personality Traits given the influence of Technology is defined as

$$P(PT) = P(PTi) + P(TE) * P(PK) \ldots\ldots eq(6)$$

Figure 7: Bayesian belief network for Personality Traits variable

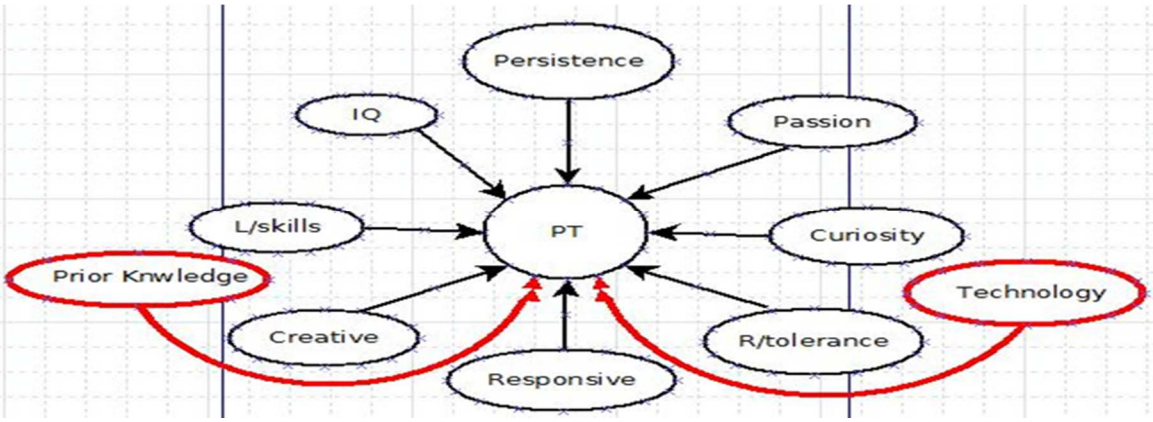
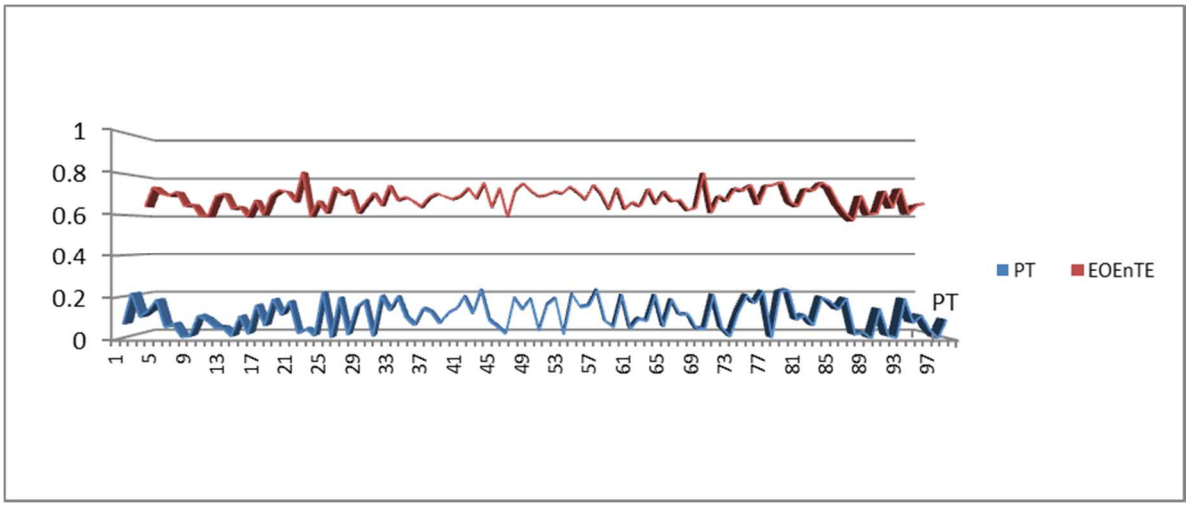


Figure 8: Graphical simulation result plot for TE influenced PT and EOE



Initial probability of Environment contribution is given as

$$P(EVi) = P(EV \mid Pol, Dev, Cul, Econ) \ldots\ldots eq(7)$$

Probabilistic value of the effects of Environment is given as same with the initial condition since the environment does not readily change over influences of other factors but is defined as a function of the favourable factors that flourish within it seamlessly

$$P(EV) = P(EVi) \ldots\ldots eq(8)$$

Initial probability of Social Network contribution is given as

$$P(SNi) = P(SN \mid Income, Family) \ldots\ldots eq(9)$$

Probabilistic value of Social Network given the influence of Education, Personality Traits and Environment is defined as

$$P(SN) = P(SNi) + P(Ed)*P(PT)*P(EV) \ldots\ldots eq(10)$$

Figure 9: Bayesian belief network for Social Network variable

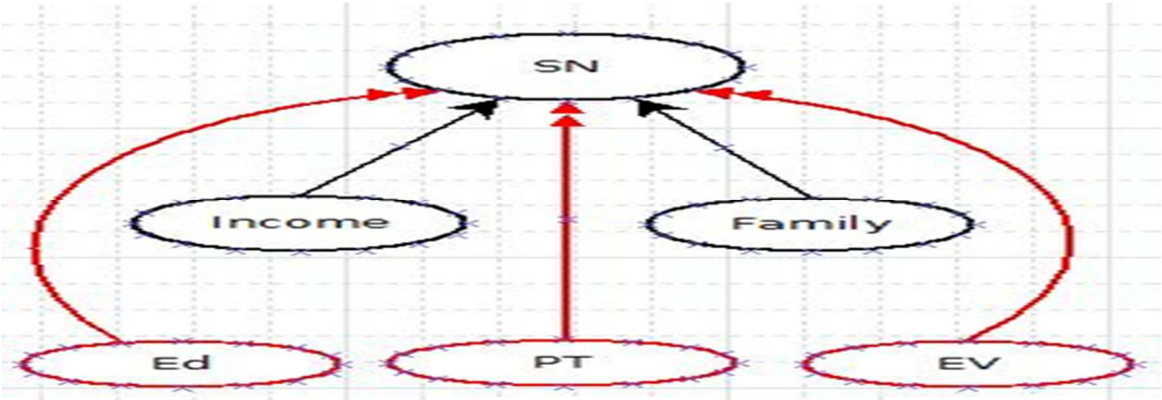
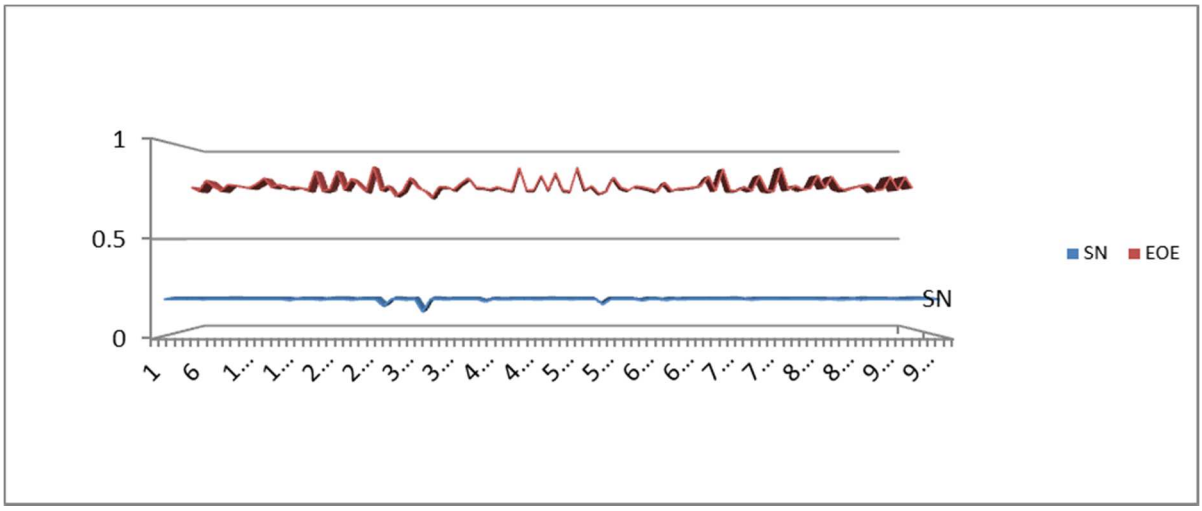


Figure 10: Graphical simulation result plot for SN and EOE



Bayesian probability equations used in determining the final emergence outputs are outlined below:

Emergence given TE

$$P(Em \mid TE) = P(Em) * P(TEi)/P(TE) \; \ldots\ldots eq(11)$$

Emergence given PK

$$P(Em \mid PK) = P(Em) * P(PKi)/P(PK) \; \ldots\ldots\ldots eq(12)$$

Emergence given PT

$$P(Em \mid PT) = P(Em) * P(PTi)/P(PT) \; \ldots\ldots\ldots eq(13)$$

Emergence given EV

$$P(Em \mid EV) = P(Em) * P(EVi)/P(EV) \; \ldots\ldots\ldots eq(14)$$

Emergence given SN

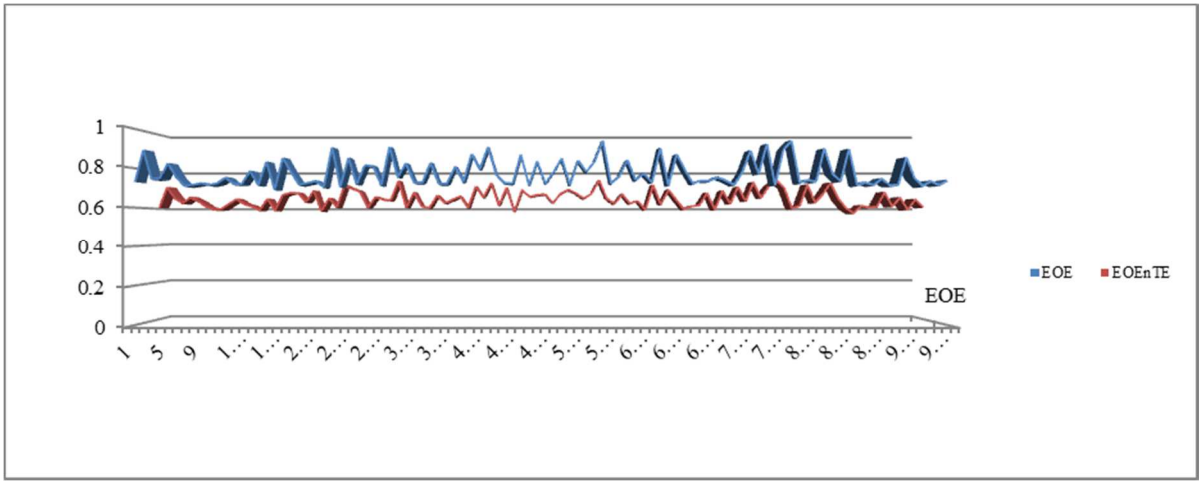
$$P(Em \mid SN) = P(Em) * P(SNi)/P(SN) \; \ldots\ldots\ldots eq(15)$$

By applying the conditional dependence in joint probability, and in the context of our Bayesian belief networks and probability, the Probability of emergence (Em) given TE, PK, PT, EV and SN is as shown below:

$$P(EEm) = P(Em \mid TE, PK, PT, EV, SN) \ldots\ldots\ldots eq(16)$$

$$= P(Em \mid TEi)*P(TE) + P(Em \mid PKi)*P(PK) + P(Em \mid PTi)*P(PT) + P(Em \mid EVi)*P(EV) + P(Em \mid SNi)*P(SN) \ldots\ldots\ldots eq(17)$$

Figure 11: Comparison of outputs for EOE and EOE with TE influence on PT



Literature has demonstrated how social network, personality and prior knowledge has influenced cognitive thinking (Shane 2000b; Kirzner 1997) in entrepreneurship but little has been said about the influence of technology and the environment in modern entrepreneurial endeavours.

The dynamics of a complex system is controlled by a wide variety of mutually dependent mechanisms that interact across and through the system hierarchy. (Mot 2010). Each mechanism creates strong instability and except for very special circumstances, none of these mechanisms alone prevail to the extent that the others can be neglected (Bird et al. 2012). Thus, creating a theory that could describe the system behaviour, by means of assembling the set of governing equations, as unrealistic and this may also become misleading (Lichtenstein 2011). The most important feature of complex systems is persistent reoccurrence of extreme and rare events of low probability but which have a high impact on the system where they occur owing to perturbation. With different connotations they are also known as critical transitions, disasters, catastrophes, and crises. Among the regular behaviour patterns of complex systems are "premonitory" examples that emerge more frequently as an extreme event approaches (Baron et al. 2006; Chwif et al. 1996; Epstein 1999). Premonitory patterns and extreme events are consecutive manifestations of a system's dynamics.

These patterns may not trigger extreme events but merely signal the growth of instability, making the system ripe for extreme events. Finding premonitory patterns creates a basis for the development of algorithms within the predictions of extreme events and is pivotal for fundamental understanding of complex systems (Sonnessa 2004). Specifically, the following types of premonitory patterns have been identified formally: intensity, clustering, range of correlation in space, and the change of scaling.

Conclusion

Attention has not been given to how much entrepreneurs' personality traits are influenced by externalities especially the extended persona of the individual or group. The results of this study show that entrepreneurs' personality traits are influenced in this way.

To properly demonstrate this influence, a conceptual framework was used which accommodates the extended persona, which formerly has been neglected in the entrepreneurship literature. In this digital age people, particularly entrepreneurs, live their daily lives with the aid of extended attributes. These include an 'extended mind' in the form of smart mobile phones, digital memory storages and daily heuristics. It becomes imperative to take account of the technology and prior knowledge that influences entrepreneurial personalities via social media and virtual environments. In the case of the modern society, it has become obvious that just an entrepreneurial mind set centred on technical and digital advancements can greatly affect the decisions that engineer ideas propagated within an entrepreneurial corridor.

A thematic examination of the result of the simulations shows a stochastic behaviour of the characteristic elements in this study, and shows an emergent phenomenon that illustrates a strong correlation between the influences of technology and personality traits on entrepreneurial innovation. A similar simulation without a technological factor shows relatively linear graphical outputs. This does not describe precise entrepreneurial patterns, as no two entrepreneurs have exactly the same experience or capacity to conceive new ideas and opportunities hence, technological inclination has become a crucial aspect of entrepreneurship regardless of the platform.

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